IN THE UNITED STATES DISTRICT COURT

FOR THE NORTHERN DISTRICT OF OKLAHOMA

STATE OF OKLAHOMA, ex rel, W.A. DREW EDMONDSON, in his capacity as ATTORNEY GENERAL OF THE STATE OF OKLAHOMA, et al.	)	
Plaintiffs,	)	
V.	)	No. 05-CV-329-GKF-SAJ
TYSON FOODS, INC., et al.,	)	
Defendants.	)	

REPORTER'S TRANSCRIPT OF PROCEEDINGS

FEBRUARY 21, 2008

PRELIMINARY INJUNCTION HEARING

VOLUME III

BEFORE THE HONORABLE GREGORY K. FRIZZELL, Judge

APPEARANCES:

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UNITED STATES COURT REPORTER

as a reliable method of tracking fecal bacteria in the environment?

A. Yes, as I said, they have several experts working on this area themselves.

Q. Dr. Harwood, I'd like to call your attention to State's Exhibit 59-1. It should be in front of you there on the lectern in front of you.

A. Yes.

Q. Would you please identify that for the record?

A. Yes, that's my CV.

Q. Is it a current copy of your curriculum vitae?

A. Yes, it looks like it.

Q. Have you recently updated that curriculum?

A. Yes, just recently we had a paper that's been published in Applied Environmental Microbiology on quantitative PCR, so that was an updated edition.

Q. You said quantitative PCR?

A. Quantitative polymerase chain reaction.

Q. So PCR stands for?

A. Polymerase chain reaction.

Q. I'm going to let you say that all day, I'm going to say PCR.

A. Okay. Me, too.

Q. When did you first become involved in the cases before the Court here today?

A. I was first contacted in August 2004 and then did not start working on the case until April 2005.

Q. Now, what is your understanding, Doctor, about the subject matter of the case that's before the Court today?

A. The Oklahoma Attorney General has filed suit against some poultry integrators in order to stop or place a moratorium upon land application of poultry litter due to environmental, ecological and human health hazards associated with that practice.

Q. Were you given any assignments in this case?

A. I was asked to help plan sampling procedures, review analytical results for microbiology analyses and render opinions on the -- on aspects of microbiological water contamination from land applied poultry litter and human health risks that could result from that practice. And also worked in conjunction with North Wind Laboratory to develop what we term a poultry litter biomarker, a specific PCR assay for bacteria that are associated with poultry litter, to use as a tracer for land applied poultry litter.

Q. Okay, Doctor. Doctor, what materials have you reviewed in order to accomplish those assignments?

A. Well, I've reviewed a lot of documents, but they include results of microbial testing that were sent to me by CDM. And the analyses were done by laboratories, three laboratories, FoodProtech, A&L Laboratory and EML Laboratory. I reviewed

little bit of sensitivity in that process.

Q. Thank you, Doctor. Who did you work with in development of this PCR process?

A. I worked with North Wind Laboratory and that was Tamzen Macbeth and Jennifer Weide were the scientists there that I worked with.

Q. Anyone else?

A. We worked with Roger Olsen in terms of we worked on the sampling strategy and collection.

Q. Do you intend to publish your findings of this study in a peer reviewed scientific journal?

A. Yes, definitely. The abstract is submitted to the American Society of Microbiology Conference which will take place in June. And the manuscript is in preparation to be submitted to Applied Environmental Microbiology.

Q. Doctor, now I want to turn your attention to Plaintiffs' Exhibit 436.

THE COURT: Doctor, I imagine this will be touched upon in cross-examination, but to the extent the manuscript is in preparation, it hasn't been subjected to peer review or scrutiny; correct?

THE WITNESS: Correct.

THE COURT: Go ahead.

MR. PAGE: Thank you, Your Honor.

Q. (By Mr. Page) Dr. Harwood, would you please identify for

break?

MR. PAGE: I would, Your Honor, thank you.

THE COURT: Let's take a recess until how's 1:30? Is that enough time? We'll be in recess until 1:30 p.m.

(Recess.)

MR. PAGE: Your Honor, thank you for calling that break. May I continue, Your Honor?

THE COURT: Yes, sir.

MR. PAGE: Thank you, sir.

Q. (By Mr. Page) Dr. Harwood, how many samples have been analyzed for PCR to date?

A. A little bit over -- a little bit over 200.

Q. And how many total samples are there?

A. About 550.

Q. And how come your analysis ends with 200 samples?

A. We had -- we received results of the sampling in October, November and January. And after that, we were instructed to stop submitting new results until after this hearing is my understanding.

Q. Thank you. I'd like to turn your attention to Exhibit 439. Dr. Harwood, can you identify State's Exhibit 439?

A. That is a graph that was prepared under my direction. And it shows on the vertical axis -- well, it's a comparison of the results for the poultry biomarker assay versus the concentration of Enterococci in various samples, including

litter, soil, edge of field, surface water and groundwater samples.

Q. What does this graph tell us with regard to a relationship between the bacteria that are shown on it?

A. Well, it tells us a couple of things. First of all, there is a significant relationship between Enterococcus concentrations and the concentration of the poultry litter biomarker in these samples. It also tells us something else. We talked about the sensitivity of the assay and how much needed to be present to be quantified and so you need about 2,000 copies of the gene to quantify. And when I prepared this graph, what I did was I used the quantitative results for this cluster. But if a sample had presence of the biomarker, but it was not enough to quantify, then I assigned it a value of one. So that's those values down here. And then if the biomarker was not present, I assigned a value of zero. So that's what these are right here.

But even though we do have this gap in the ability to quantify in this area, we still do have a strong correlation between Enterococci and the Brevibacterium poultry litter biomarker. And you see here the P value is .0001 which means that there is only one chance in a thousand that this relationship between the variables is occurring by chance.

Q. Does it tell us anything about the relationship between poultry waste and the Enterococci indicator bacteria we're

finding in our samples?
A. Well, it does say that they co-occur. So when you tend to have high levels of Enterococci, you also tend to have high levels of the biomarker.
Q. Thank you. Now, let me show you Exhibit 438.
A. That's a very similar graph except that shows the relationship of the biomarker, the poultry litter biomarker, with E. coli concentration. And it's another indicator bacteria that we're using for general fecal contamination.
Q. Again, does it indicate anything with regard to the relationship between the E. coli that's found in the environment and the PCR Brevibacterium?
A. Well, again, when we have high levels of E. coli, we also tend to have high levels of the Brevibacterium.
Q. Thank you. And then again, let me show you what's been marked as Exhibit 440.
A. This is a similar relationship but with the fecal coliform indicator bacteria and again showing a similar trend, again a highly significant correlation of .0001.
Q. And does it tell us anything with regard to the relationship between the fecal coliform and poultry waste?
A. So as fecal coliform numbers tend to be high, so does the concentration of the biomarker and vice versa, as they tend to be low, the concentration of the biomarker tends to be low. So they are correlated, they tend to co-vary.

Q. Does that mean the poultry waste biomarker co-varies with the indicator bacteria?
A. Correct.
Q. What is the chance of, let's say, a mistake in this analysis?
A. That would be, again, it's P less than .0001, so less than one in a thousand that this relationship occurred by chance.
Q. Now, Dr. Harwood, earlier I believe you stated an opinion concerning the importance of poultry waste as a contaminant, a bacterial contaminant in the IRW?
A. Correct.
Q. Would you please restate that opinion?
A. Yes, my opinion is that the poultry waste -- land application of poultry waste in the IRW is a major contributor to elevated indicator bacteria loads in the Illinois River Watershed in these waters.
Q. Now, what evidence did you use to reach this conclusion?
A. I used the weight of evidence approach which is what typically one does when investigating ecological questions. So rather than relying on one line of investigation, integrated numerous lines. So that would be starting out with -- and not in any particular order. But since we're talking about it, the widespread and quantifiable presence of the poultry litter biomarker and the evident pathway in terms of its concentration gradient from the litter to the fields to the edge of the field

and then to surface water and groundwater samples. The chronic impairments of water quality in the Illinois River Watershed. And then the lines of evidence from Roger Olsen's principal components analysis work demonstrating a poultry signature throughout the watershed and the work of Dr. Fisher on the geology, hydrogeology of the area and the work of Dr. Engel on demonstrating the amount of an application of the litter. So all of these lines of evidence then taken together contribute toward this opinion.

Q. Okay. So then in summary, could you state what your opinions are with regard to the issues you've been asked to address in this case?

A. Well, maybe I'll try to work my way backwards. My opinion is that we have -- that the poultry biomarker assay is a reliable, validated assay for use in tracing the pathway of poultry litter contamination throughout the watershed. This -- the poultry litter concentrations co-vary with the indicator bacteria concentrations so demonstrating that this is a significant source of the contamination in the IRW.

Q. What is a significant source?

A. Poultry litter, waste. And that the -- these elevated levels of indicator bacteria are indicative of a threat to human health for recreational water users. And so taken together then this would indicate that the practice of spreading the poultry litter, if stopped, would result in a

and end users?
A. That's correct, and that's the body of literature that has been accumulated since 1996.
Q. You also wrote just last year that the fact is that the field has not yet reached the state where any one method can be discarded or universally recommended?
A. Yes. That's why we rely on weight of evidence in these types of studies.
Q. Hasn't the EPA said as late as 2005, there is no single microbial source tracking method that could be applied to all types of fecally-contaminated water systems?
A. Yes.
Q. All right. Let's turn from the general field of microbial source tracking but before I do, let me end just with a question. So in microbial source tracking, what you are trying to do is you find feces in the environment and you are trying to say where it came from?
A. No, you don't find feces. You are usually looking at water bodies and then you're trying --
Q. Ah, you find a bacteria and you are trying to say where that bacteria came from?
A. Or trying to say where fecal contamination in the water came from.
Q. And you do that by trying to determine where the bacteria came from?

A. Yes, I have. Essentially when you determine the nature and extent of contamination, that always involves trying to figure out, you know, where the source is, to a source identification. You have to know the sources before you can clean up the site and that's one of the objectives. There's always been, besides over those hundreds of sites that I've worked on that, I've been asked specifically by clients to identify sources in the environment.

Q. How many sites have there been where you've been specifically tasked with identifying the source of contamination at an environmental site?

A. All those, over 100 sites plus more.

Q. Do you have techniques that you typically employ when you go about the process of determining sources of contamination?

A. Yes, we do. It's always a weight of evidence approach. We like to put all the pieces together. And a variety of techniques we use is -- one of the main ones we use is what I call a pathway sampling approach. It's looking at the site conceptual model and really getting samples in all the various environmental components clear from where the source could be to where it ends up. We also do other types of spatial analysis, spatial sampling, upgradient and downgradient of potential sources. If we can get actual sources, we would analyze those, too. We compare results with standard waste profiles to see if they match to determine sources. We look at

indicator parameters of particular sources that may be prevalent throughout the basin. We look at unique indicators also, for instance, like the PCR that Dr. Harwood has been talking about. We do trend analysis like Dr. Fisher talked about in the cores, looking at concentrations changing with time. We also do simple correlations like he did. And we also do some additional more sophisticated statistical analysis.

Q. Now, did you employ those techniques in evaluating the source of contamination of this site?

A. Yes, I did. I took into weight many of those types of techniques.

Q. So they form the basis of your opinions here today?

A. That's right.

Q. Now, Dr. Olsen, just briefly tell us the clients that you've been employed by to specifically identify sources of contamination.

A. Again, that would be the EPA. Department of Justice specifically employed me to determine sources, municipalities, state governments and some private industry, too.

Q. Have you done any work for the Department of Defense in identifying sources of contamination?

A. Yes, the Department of Defense, too.

Q. How about the Corps of Engineers?

A. Yes, sir.

Q. About how much of your work in identifying sources of

A. Yes, it is. I did a quick review of peer reviewed literature and found over a dozen papers that had used PCR as a technique to identify sources.

Q. PCR or PCA?

A. PCA. You got me confused already.

Q. See, I said it and I threw you off, didn't I?

A. PCA to identify sources, yes, sources of contamination.

Q. Which clients have you used PCA for to identify sources of contamination?

A. I've used it for Department of Justice, EPA, three private clients, two state agencies.

Q. Have you used -- excuse me. Have you published anything with regard to PCA?

A. Yes, I have.

Q. What was that?

A. Again, one of the specific tasks I was given was by the U.S. EPA. It was called the Sharon Steel Superfund site which is in Utah. And they specifically asked me to identify the source of arsenic in the groundwater and PCA was one of the main techniques I used to do that for them and I published the results of that.

Q. Dr. Olsen, have you ever given testimony in state and federal courts in the past?

A. Yes, I have.

Q. In what areas have you been qualified as an expert?

Q. Did legal counsel have any control over the methods or means of analysis that you employed?
A. No, of course they reviewed those methods, but essentially we had a free hand to employ methods that we wanted to use.
Q. Now, Dr. Olsen, I'm going to want to put up two demonstrative exhibits that I'd like you to refer to as you discuss the sampling plan and how it works. Now, Dr. Olsen, I've just put on the tripods and I think before you there's a smaller version of State's Exhibits 450 and 452. Can you identify those for the record, please, sir?
A. Yes, 450, the diagram on the left, is essentially a schematic of the basin. Previously I'd referred to a site conceptual model, this is one method that we put together site conceptual models. We usually write them out, but that illustrates the various components of the site and the pathways that the contamination moves out throughout the site. And on the right, I've actually taken various parts which I call components from that site conceptual model and put them in boxes. And this illustrates, again, what I called in my weight of evidence approach, my pathway component sampling approach.
Q. Dr. Olsen, could you just briefly explain what you mean by pathway sampling approach?
A. Essentially a pathway sampling approach is a means to trace the contaminants from their source or near their source completely through the environment to where they actually end

up.

Q. Dr. Olsen, using those two demonstrative exhibits, 450 and 452, could you go step-wise through the sampling program that was developed?

A. Yes.

Q. Would you begin with the first step and identify for the Court what that step is?

A. Yeah, first of all, we all know that there are a variety of poultry houses across the landscape in the Illinois River basin. So our first step was really to go into the poultry houses and get actual waste samples from the poultry houses. So that is this first box over here. It just shows some poultry houses and actual waste being -- that has been loaded into a truck waiting disposal. We had a design sampling plan for that that followed state guidelines that was reviewed and approved to get a representative sample from each of those houses that we were able to get into.

Q. The first step was to sample the litter in the houses?

A. That's right.

Q. Why did you choose to sample the litter in the houses?

A. Again, that's the source. We need to know the chemical composition of the source material itself.

Q. And that's depicted on State's Exhibit 452 in the upper right-hand corner?

A. Yes, that's this box here.

Q. I notice there's white lines on State's Exhibit 452. What do those designate?
A. Those white lines illustrate the pathway that the waste and the contaminants would travel throughout the environment, in this case from land application, clear into Lake Tenkiller.
Q. Okay. Would you go to the second step of the pathway analysis that was employed for the sampling plan?
A. Again, the waste is trucked out and spread on fields. And on the site conceptual model, we have some trucks that are spreading waste, but I illustrated that by this box here which actually shows the waste being spread on a field. So our second component was to sample the soils where the waste had been applied and again we designed a very systematic program to do that. We ended up sampling 66 fields where poultry waste had been applied and 83 subareas. In each of those 83 subareas, we created a grid of 20 samples and collected samples at a routine grid clear across the field and them composited all those samples to get a representative analysis.
Q. Okay. And I notice now from that second box there's lines going two different directions. What is the next pathway?
A. There's two principal things that can happen once the waste is applied on the soil. It can run off during rainstorms or it can infiltrate into the groundwater and end up in springs or wells or the alluvial water. I'll talk about this first component. We already heard about a lot of collection of

what's called edge of field samples, that's actually collecting runoff from the fields. And Dr. Fisher talked about having investigators in the field and then tracking where disposal was. Our staff in the field were usually notified every day where they had documented application of litter in fields and they kept a running list of those locations. They went to all those locations and inspected them. They looked for where runoff would occur. They looked at the slope of the land. They looked at where gullies would be that water would run off the field. And they were in the basin and on 24-hour standby that when a rain occurred, they would get out there as soon as possible and go to these predetermined locations where the water would run off and actually collect runoff. They actually got some samples when it was raining and when water was actually flowing off the field because they were there very quickly after the rainfall occurred.

Q. Dr. Olsen, you mentioned the people out in the field on 24-hour standby. How many employees were utilized by CDM in the sampling, collection process over the last couple of years?

A. We typically had a core group of 15 to 20 people that were out there all the time, but overall we've brought in people and employed over a hundred different CDM people on the site.

Q. Thank you, sir. Now, will you go to the next component of pathway?

A. Yes, the next one is also very important. After it runs

off the field, it can run into small streams and it can get into bigger streams. Now, I divided it into two components here. One I called high flow and one I called base flow. We sampled both small basins and larger basins both during high flow and base flow. Now, the high flow in small basins, we designed a specific plan for that and we had to install automated samplers. That is, you have to get the sample right when it starts flowing down the stream and you can't be out there all the time. So there's samplers that are called ISCO samplers. They have 24 bottles in them and they are programmed to essentially start collecting the bottles at a regular intervals when the height of the water gets to a certain stage and those are called high flow samplers. Now, those were designed and placed in the basin a very specific way. It just wasn't --

Q. Would you explain that to the Court, please?

A. Sure. It's actually we use what is called a stratified design. In fact, all our surface water sampling was done with a stratified design except some opportunistic samples that we collected. And if I can best explain this in some simple terms. Suppose we had an area with low or no impact, we had an area with medium impact and we had an area with high impact --

Q. What do you mean by impact, low, medium --

A. Well, in this case it would be contamination. So we identified areas with little or no contamination, medium

contamination and high contamination. And then we would put the -- collect the same amount of samples in each of those three ranges of concentrations. Here at this site we actually identified five ranges for the small basins and put the same amount of samplers in each impact area or each concentration range. And this was important so that we never collected samples that were biased one way or the other. We got the complete range of contaminant concentrations.

Q. Did you also collect samples where there was no contamination from poultry waste?

A. Yes, we did. We --

Q. Or no expected contamination from poultry waste?

A. Yeah, we identified -- for surface waters we identified three areas outside the basin that were not impacted by poultry waste. And then we looked for a long time and we identified two basins inside the watershed that had minimal impact. So overall there were about five locations that I would say that had no impact or very low impact that we used for comparisons.

Q. Dr. Olsen, why did you design a plan that would sample both low flow and high flow conditions?

A. Yeah, I should say that on the bigger streams -- this just wasn't on the smaller streams. We had a cooperative agreement with the USGS and they did sampling for us, both high flow and base flow at six of their stations in Oklahoma. So it was important to get base flow conditions because base flow

conditions are essentially waters from -- that have infiltrated, that are in -- go through the terrain like Dr. Fisher explained and end up in the river. Base flow is also considered direct discharges like from wastewater treatment plants. And then we also collected high flow stations. Again, I already explained when that occurs. I recently did an analysis of how much high flow versus base flow we had in those stations and it was 50-50. The samples we collected were almost identically a 50 percent base flow and 50 percent high flow samples.

Q. In addition to wastewater treatment plant discharges, would there be other contributors to base flow?

A. The groundwater itself that infiltrates through the fields, that's the principal component of base flow.

Q. Did you have streams where there was no wastewater treatment plant contribution at all where you obtained base flow samples on a regular basis?

A. Yes, most of our high flow stations in the smaller basins had no wastewater impact at all. That was part of the design too. Now, in addition to just a stratified design on the automatic sampling stations in the smaller basins, we did basin-wide surface water sampling. And here we used the same approach. We essentially went out to every place that we could get a water sample. We identified 300 spots across the basin and we collected what we call indicator parameters.

Q. When you say you went to every place you could get a sample, what do you mean by that?

A. Well, there's only so many public access places across the basin. So we went to most of the bridges that were on rivers where we could get to the water itself. So we identified 300 locations. We were actually able to get water at 200 of those locations. Some of those locations didn't have water. And we analyzed for indicator parameters, a small group, in this case, phosphorus and nitrogen species. And essentially we, again, stratified where we would take our more detailed samples that I used for my statistical evaluation by dividing all those concentrations into five equal ranges and making sure that I had the same number of samples in each of those five concentration ranges. Then we did one step further, we actually randomly selected locations that were inside each of those concentrations.

Q. What was next after you sampled the rivers and streams?

A. Eventually that water ends up -- maybe I'll go back to this diagram. There's some of the smaller tributaries that water runs off the fields and gets into the small tributaries and it gets into the larger rivers, the Illinois, the Caney and Barren Fork, then it eventually ends up in Tenkiller here. And so that's a location -- that's a picture down here. But we designed, again, a sampling plan in Tenkiller. It was four locations that were spaced throughout the different depths and

different environments in the lake. And then we sampled at multiple depth according to the stratification.

Q. In addition to water in rivers, streams and lake, did you do any other sampling in those locations?

A. Yes, we did sediment, too. Again, when rainfall occurs, if it's heavy enough, particles and dissolved contaminants will run off the fields. So we actually collected sediments throughout the various streams. And Dr. Fisher has already described the core sediments we collected in Lake Tenkiller.

Q. Okay. What was the next path that you examined?

A. Let's go back to the application on the field itself. Again, I already said some of that water infiltrates. We actually had three programs to look at groundwater or water that infiltrates. The first one was actually to go to springs. And this wasn't a stratified design, we just sampled every spring we could find in the basin and had access to. Again, that would be a component of flow. As Dr. Fisher explained, infiltration gets into the karst, travels along the fractures and it comes out in particular locations as springs.

The next type of groundwater sampling we did was, people are going to refer to it as geoprobe samples. It's really a hydraulically driven tube that's kind of a temporary well. And these we used to get shallow alluvial samples, usually by major rivers where there is alluvial.

Q. What's the purpose of getting those alluvial samples in

this approach?

A. Well, again, that represents a pathway component of where groundwater would end up after it's infiltrated and just before it enters the river.

Q. Thank you. Please continue, Doctor.

A. And the last type of groundwater we sampled were residential wells in Oklahoma. And we targeted wells that were less than 150 feet and at a variety of distances from known chicken houses.

Q. How successful were you able to get a random stratified design for groundwater wells?

A. Again, we tried to stratify it somewhat, but it was only for Oklahoma. And we tried to get various distances from chicken houses. Our ultimate success was a lot of times we couldn't get permission to sample wells, so we got where we could get. And my analysis of it is that it is representative of that pathway showing that contaminants can migrate into groundwater and residential wells, but it isn't representative of all the wells in the basin.

Q. So let me make sure I understand what you are saying. You're saying it's representative of a pathway, for example, of what would illustrate migration; is that correct?

A. Yes, it definitely is representative and precise and accurate enough to represent that that pathway exists for contamination to get into residential wells.

Q. Would the spring sampling data and the geoprobe alluvium also be indicative of that pathway information?

A. Yes, particularly the springs is more rigorous because we got all the springs we could across the area. This little -- that's actually a spring house. You can't kind of tell what that is.

Q. That's a discharge from a spring house?

A. Yes.

Q. Is that algae on the rock there next to it?

A. You'll have to ask our algae expert.

Q. Dr. Olsen, but is it your testimony that it's representative from a pathway approach, but it wouldn't be representative trying to characterize all the contamination of all the groundwater in the basin; correct?

A. That's right.

Q. Now, you mentioned USGS was part of the sampling program?

A. That's right.

Q. What part did they play again?

A. We worked with them. They have a routine sampling program out there. Of course, there are permanent gauges was out there. There was one gauge that they hadn't sampled for awhile that was on Caney Creek. We added that gauge as a routine sampling. So we ended up with six gauges that they sampled for us, both at high flow and low flow -- excuse me, high flow and base flow. And some of the parameters that we wanted, they

didn't typically analyze for. So we expanded that list of parameters and asked them to analyze that more extended list of parameters so that we had a more complete picture of contamination in the basin.

Q. So the data that USGS provided, that was based on their existing sampling locations?

A. Yes, six of those.

Q. Did they have historical information that was utilized by you and others in this analysis?

A. Yes, there is an extensive record at some of those stations.

Q. So the gathering by USGS of additional data allowed you to do some comparisons; is that correct?

A. That's true.

Q. Okay. Why did you employ this pathway or why did the team employ this pathway sampling approach here?

A. We forgot that last aerial where a lot of that groundwater ends up --

Q. Oh, thank you.

A. -- again, as base flow in the streams and we already talked about that, but that completes the cycle.

Q. Thank you for making that clear.

A. No, that's fine. Your question was, why did we employ this? Again, it's just simply we want to see if we can trace the contaminant throughout the entire basin from its source

clear through the various environmental components to where it ends up. And this is consistent with our hypothesis to determine whether there's observable effects throughout the basin.

Q. And did the group of experts in the team actually employ this sampling approach and gather samples from all these different components during your investigation?

A. Yes, they did.

Q. And what did you conclude based on that analysis?

A. I concluded that there was poultry contamination in all these components.

Q. Was it -- I'll hold that question. Now, let's put before you Plaintiffs' Exhibit 453. Dr. Olsen, I put it up on the tripod for you but there's also a copy of that exhibit before you. Can you identify State's Exhibit 453, please?

A. Yes, this just is a summary that I prepared that shows the total number of samples that we had collected and analyzed for some parameters, at least some parameters and sometimes extensive parameters in each of the pathway components that I just talked about.

Q. So is this a summary table you prepared from all the samples and analysis that have been taken thus far in the Illinois River Watershed on this case?

A. Yes, sir.

Q. Would you briefly go down the list and identify or remind

us of what those components are with respect to the analysis we collected?

A. Yes, there's 20 poultry waste samples. We collected waste in all the defendants' houses except Willow Brook and Cal-Maine. We collected soils from 66 fields and 83 subareas for a total of 202 actual soil samples. And just as we had control or references or unimpacted areas for surface water, we actually had those for soils too. We had six fields that didn't have any fertilizer or didn't have any waste, animal waste at all applied to them. We collected 86 edge of field samples, I've already described those. Groundwater, of all lumped together, 135 samples. If I remember correctly, that breaks down to 19 geoprobes, 56 springs and 60 wells, residential wells. So again, three types of groundwater. By far the most we collected were river and stream samples throughout the basin, high flow and low flow, high flow and base flow at various places throughout the basin.

Here's the sediments we talked about both in -- these are just the river and streams, this is lake water, that's Lake Tenkiller. We also had a -- some control samples in Broken Bow. These are the lake sediments that Dr. Fisher previously talked about.

Q. You mentioned stratified random design in the different compartments. Did you also employ any geographical analysis in your sampling plan?

A. Yes, for the rivers and streams besides the stratification on concentrations or impact areas, we also stratified it geographically across the basin by dividing the basin into blocks and making sure we had the same number of samples in each of the blocks.

Q. What were the total number of samples that have been collected so far in support of your and others' analysis in this case?

A. This total is over 2,600.

Q. Now, as part of this sampling plan, did you prepare or did the team prepare documentation to record the accuracy and reliability of the samples that were taken?

A. Yes, I used the same procedures that I would use on any EPA Superfund site. Those are the best established there are and so we use those on this site also.

Q. Okay. Could you outline for the Court those procedures that you employed?

A. Certainly. The first thing we do is, again, we develop a scope of work. And that's more of a general statement of what we're going to be doing, the purpose of that, the approach -- sampling approach we're going to use, the analytical scheme we're going to employ. And we did that with the experts, we developed that with the experts, various experts in each of the environmental components that we talked about. Then we actually developed a standard operating procedure. And again,

A. Yes, that was -- I'm glad you clarified that. That was only done for the quantitative PCR analysis.

Q. Okay. And you took those cattle samples of waste and you took them to a lab and had them analyzed in terms of their chemical composition; correct?

A. No.

Q. You did not?

A. No, I did not.

Q. You had that material, you could have sent it to a lab and had it analyzed; correct?

A. Yes, and we plan to collect cattle samples now and do that exact same thing.

Q. Well, why haven't you done it already?

A. Well, you can see the -- this is the way a principal component works. If the waste is there and it's significant, for instance, the cattle waste or the wastewater treatment plant. By the sampling we did, you're going to see that waste signature if it's significant. We, of course, saw the wastewater treatment plant signature. We didn't see the cattle signature. My conclusion is that the cattle signature is not significant. I went to specific samples that I knew had cattle waste in it and I could see a distinct difference, particularly with the poultry waste. So I knew what I was looking for and it just wasn't a dominant signature across the basin. I found it in, like, significantly in one spring sample and I found it

not significant in three other spring samples. I found it significant in four edge of field samples and not so significant in five others. So it's just not a dominant signature across the basin. If it would have been, I would have found it.

Q. Sir, okay, I think you're answering a question other than the one I asked, sir. So if at all possible, I'd ask that you keep your responses to my questions. Dr. Olsen, your comment that you validated your belief that you can exclude this cattle signature by going back to specific locations is limited to the information you have about which edge of field samples and which fields are affected by cattle; correct?

A. No.

Q. Sir, you don't know, with respect to all the places that you collected edge of field samples in this watershed that you believe are poultry litter signature samples, the extent to which those areas are impacted by cattle, do you?

A. I know exactly what waters and what edge of fields are impacted by cattle and which are not because it has a completely different chemical composition and I can tell the difference.

Q. Let me move away from how you are interpreting the results and let's talk about what you actually know about the field, okay, sir? With respect to the edge of field locations where you have detected what you believe is a poultry litter sample,